HAWC

A High-resolution Airborne Wide-band Camera for
SOFIA

When SOFIA enters operation, it will be the largest far-infrared telescope available, so it will have the best intrinsic angular resolution. HAWC is a first-generation facility instrument for SOFIA. It is a far-infrared camera designed to cover the 40-300 micron spectral region at the highest possible angular resolution. HAWC's goal is to provide a sensitive, versatile, and reliable far-infrared imaging capability for the astronomical community during SOFIA's first years of operation.

HAWC Science

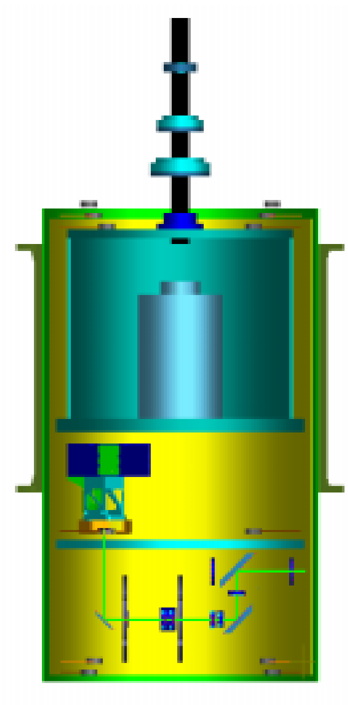
Many infrared sources are dusty. Absorption of starlight typically heats the dust grains to temperatures of tens or hundreds of degrees Kelvin. They radiate most of their energy in the far-infrared at wavelengths of 40-300 microns which are inaccessible from the ground. Imagery in this spectral range with the highest possible angular resolution is the natural starting point from which to develop an understanding of source energetics and morphology. It also plays a central role in studies of the physics and chemistry of the interstellar clouds which feed and catalyze the evolution of stars and galaxies.

SOFIA's angular resolution will make it possible to study the evolution of stars, planetary systems, and galaxies in unprecedented detail. SOFIA will provide the first far-infrared images which can be directly compared with the wealth of arcsecond-scale data now available at other wavelengths. Its light gathering power will allow studies of many sources in a wide range of environments, from low-mass stars in nearby dark clouds to young star clusters in low-metallicity dwarf galaxies to luminous starbursts in merging galaxies and active galactic nuclei. Some of the scientific problems which will be addressed include the following:

- The formation of stars and stellar clusters within our galaxy.
- Star formation in external galaxies.
- The nature and evolution of protoplanetary and remnant disks around nearby stars.
- The structure and energetics of interstellar clouds.
- The return of gas and dust to the interstellar medium from evolved.
- Conditions in regions surrounding active galactic nuclei.

The drawing to the right shows a cutaway view of HAWC's critical optical and cryogenic systems. The bolometer detector array is cooled to a temperature of 200 mK by an adiabatic demagnetization refrigerator which operates from a base temperature of 4 K provided by a liquid helium reservoir and two vapor-cooled radiation shields.

The optics consists of three interchangeable sets of re-imaging lenses which enable optimized, diffraction-limited imaging at wavelengths of 60, 110, and 200 µm.



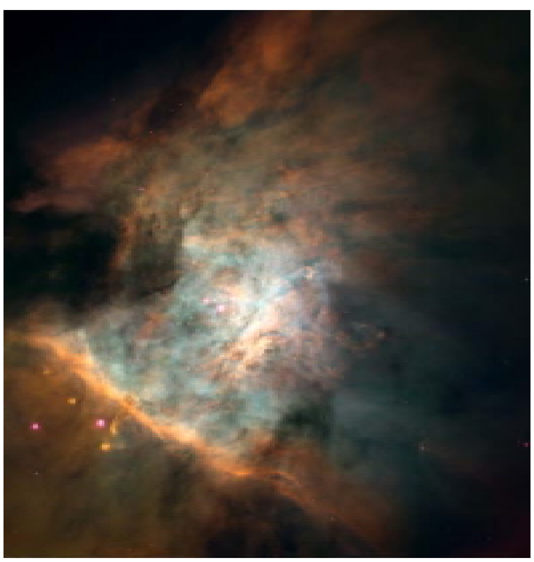
HAWC Characteristics

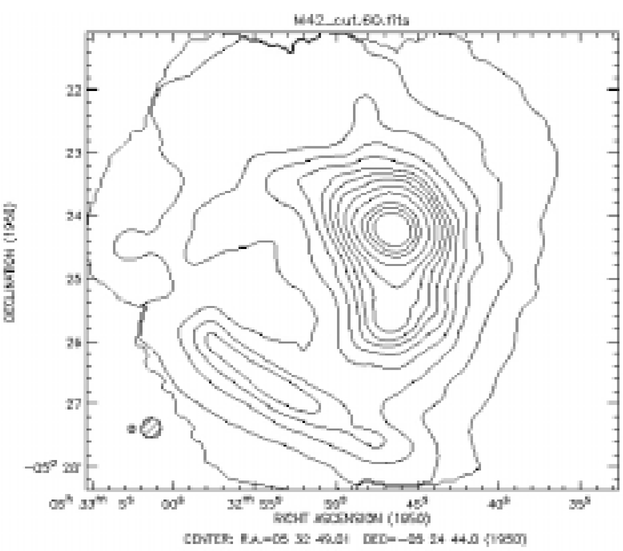
HAWC is a broadband, far-infrared camera designed to cover the 40-300 micron spectral region at the highest angular resolution possible with SOFIA. Its detector is a 12x32 pixel array of silicon bolometers. Its expected characteristics are given in the following table.

	Units	Band 1	Band 2	Band 3
Central wavelength	µm	60	110	200
Bandwidth	$\Delta\lambda/\lambda$	0.5	0.5	0.5
Pixel size (2 pixels per Airy disk fwhm)	arcseconds	2.8	5.1	9.3
Field of view	arcseconds	34x90	61x163	112x298
NEFD (extended source, background limit, Airy disk fwhm)	Jy/Hz1/2	0.35	0.45	0.28
NEFD (point source, background limit, Airy disk fwhm)	Jy/Hz1/2	0.7	0.9	0.56
NEFD (point source, background limit, Airy disk fwhm)	mJy (1 hour)	8.2	10.6	6.8

Science Example

Studies of the formation of massive stars inevitably begin with the Orion Nebula, the nearest and best-studied example of the phenomenon. The left-hand image below was taken with the Hubble Space Telescope at visual wavelengths. It shows a wealth of detail at angular scales which have been heretofore inaccessible to far-infrared telescopes because of diffraction by their relatively small apertures (compare the 60-µm contour map at the right, which was taken with SOFIA's predecessor, the Kuiper Airborne Observatory). SOFIA's large aperture will allow it to resolve the separations of the stars and protostars in the compact clusters in the core of the Orion molecular cloud and the wealth of detail in the extended emission apparent at shorter wavelengths. The KAO image shows the 18" KAO beam and the 6" SOFIA beam in the lower left.





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